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(54) Variable velocity conveying method and apparatus for continuous motion saws

Geschwindigkeitvariables Transportverfahren sowie Vorrichtung für kontinuierlich angetriebene Säge

Méthode pour transporter à vitesse variable et dispositif pour des scies à mouvement continu

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Description

BACKGROUND AND SUMMARY OF INVENTION:

This invention relates to a variable velocity conveying method and apparatus for continuous motion saws and, more particularly to a skewed orbiting saw for transversely cutting continuously advancing elongated lengths of multi-ply material into shorter lengths.

This invention is an improvement on co-owned Patent RE 30,598 and reference may be had thereto for details of construction and operation not set forth herein. The '598 patent employed a saw moving through an orbit which was skewed to the direction of movement of the multi-ply material. One advantageous application has to do with "logs" of convolutely wound paper such as are used for kitchen toweling and toilet tissue. In the manufacture of such household products, a web is unwound from a parent roll of five to nine feet in diameter and eight to eleven feet in axial length, transversely perforated and then rewound into a "log" having the diameter of the retail size roll. Thereafter, the elongated log is transversely severed into axial lengths corresponding to those found on the store shelves. This transverse cutting has been advantageously performed in the past by means of orbiting log saws. Also such orbiting log saws have been employed to separate elongated stacks of interleaved web material such as facial tissues and toweling. The above-identified '598 patent represented a major breakthrough because prior to the skewed orbit saw, the saw operation had to be limited while the log was indexed past the saw for the next cutting position. By using the skewed orbit, the log could be advanced continuously because the saw traveled with the log during the cutting operation. The producers of wound superimposed plies such as toilet tissue and toweling logs and stacked superimposed plies such as folded tissue and toweling are continually demanding increased efficiency which includes reduced down-time for maintenance such as that to correct infeed product conveyor chain wear and also for product changeover such as various cutoff lengths.

There is no teaching in the '598 patent about changing the cut length of the product and the only way employed during the years of use of the '598 mechanism was to change the angle of skew. This required a change in the mechanism which oriented the saw perpendicular to the path of material to be cut.

These problems have not been solved by the current state of the art and the invention herein described does solve these problems by providing a method as defined in claim 1 and apparatus as defined in claim 3.

For example, as the infeed product conveyor chain wears, the velocity profile can be altered by pushbutton to compensate for it. As the cutoff requirements change based on various product or marketing demands, the velocity profile of the infeed product conveyor can be changed by pushbutton. An added advantage to the non-uniformly advancing of material is the ability to reduce or eliminate the cut error produced by the mismatch in velocity between the infeed product conveyor and the disc blade when uniformly advancing the infeed product conveyor. By eliminating this mismatch, a higher quality square cut is achieved.

The inventive saw uses the same skewed orbit axis as the '598 patent but provides a means for accelerating and decelerating the log during the short time period of the cutting cycle. Where the speed variation is between cuts, the roll cut length can be varied from the nominal, constant speed case. Even further, the means for accelerating and decelerating can be used to match the blade motion at the log. More particularly, variation of the inventive concept is where the log speed is non-uniform during cutting to match the actual, (sinusoidal) motion of the saw. According to the invention, a drive such as a servo motor is provided to vary the velocity of the product conveyor system on a continuous motion saw for achieving the objectives, i.e., solutions to problems, set forth above. Thus, in particular, the invention provides a means and method for correcting for chain wear. It provides a means and method for quick change of cutoff length and it provides a means and method for eliminating theoretical cut error due to mismatch in velocity between the blade and product during cutting.

Other objects and advantages of the invention may be seen in the details of construction and operation set down in the ensuing specification.

BRIEF DESCRIPTION OF DRAWINGS:

The invention is explained in conjunction with the accompanying drawings in which --

FIG. 1 is a side elevational view (somewhat schematic) of a log saw system based upon the prior art but incorporating certain features of the invention;
FIGS. 2-5 are all representative of the prior art, FIG. 2 being a schematic diagram of the path of blades which are described further in FIGS. 3-5;
FIG. 3 is a schematic representation of a series of cut rolls from an elongated log;
FIG. 4 is a chart of blade movement to achieve the cuts represented in FIG. 3 and in terms of the positions designated in FIG. 2;
FIG. 5 is an enlargement of the encircled portion at the right hand end of FIG. 4;
FIG. 6 is a view similar to FIG. 3 but in which the invention is employed to provide a non-uniform log velocity by virtue of acceleration/deceleration between cut intervals;
FIG. 7 is a view similar to FIG. 4 and correlates the movement of the log to the cuts illustrated in FIG. 6;
FIG. 8 is a view similar to FIG. 5 but showing the acceleration/deceleration characteristic of the invention and being an enlarged version of the encircled version of FIG. 7;

FIG. 9 is a view similar to FIG. 8 but showing a deceleration/acceleration movement of the log between cuts whereby the cut roll length is shortened -- as contrasted to being lengthened as is the case with the showing in FIGS. 6-8;

FIG. 10 is a view similar to FIGS. 3 and 6 but showing the effect of blade correction at the log;

FIG. 11 is a view similar to FIGS. 4 and 7 and relating to the showing of the log movement (sinusoidal) which is further illustrated in FIG. 12; and

FIG. 12 is an enlarged view of the encircled portion of FIG. 11.

DETAILED DESCRIPTION:

Referring first to FIG. 1, the numeral 20 designates generally the frame of the log saw. This frame is advantageously supported on the floor 21 of a converting plant -- as is the log conveyor generally designated 22. The conveyor 22 is seen to be advancing a log L past an orbiting saw generally designated 23. The principal feature of the saw is an orbit head 24 which carries a pair of saw blades or discs 25, 25'. The operation of the structure described thus far is precisely that set forth in the above identified '598 patent and express reference is hereby made thereto for details of construction and operation not set forth herein.

Prior Art Operation

The prior art operation is summarized in FIGS. 2-5. The significant thing to note is shown in FIG. 5 wherein the numeral V_c designates the velocity profile of the log conveyor 22. It is a straight line and thus the velocity is constant throughout the operation. This same constant velocity is reflected at V_c in FIG. 4 and has been used to advantage over the years to produce retail size rolls of an axial dimension d of 4.125", for example. This is designated in FIG. 3 where the showing is of a log which has been produced on a 100" wide machine. This yields 24 individual rolls of 4.125" axial length d with 1/2" trim annuli 26, 27 at each end -- see the upper right hand portion of FIG. 3. This is achieved by the blades 25, 25' which act in sequence on the log, being designated Blade 1 and Blade 2 in FIG. 4. Each blade goes through a cycle designated A-C. For example, the saw 25' of FIG. 1 is in the "C" position of FIG. 2. The additional small circles as at 28 in the showing in FIG. 2 represent sharpening stones for the disc blades 25, 25' which are not shown in FIG. 1 but are conventional in this art.

Referring again to FIG. 4, the symbol V_c refers to the velocity of the conveyor which, as referred to in FIG. 5 is constant. On the other hand, the velocity (V_B) of the saw blade in the direction of product travel has a sinusoidal path or profile. As the saw proceeds clockwise downwardly as seen in FIG. 2 there is a forward velocity between points A and E but a negative or rearward velocity between points E and A.

Lastly relative to the prior art, it will be noted in FIG. 5 that there is a relatively short portion of the path of the disc saw blade wherein cutting occurs -- this being at the top of the sinusoidal curve between "START" and "END".

To achieve the benefits of the invention, a servo controller and amplifier 29 is provided -- advantageously on the frame 20 associated with the log saw. This is connected to the servo motor 30 by lines 31 and to the master encoder 32 by the line 33. The numeral 34 in the upper central part of FIG. 1 designates the orbit head motor.

The servo controller 29 is also connected by line 35 to a flight conveyor home position detector 36. In normal operation, the detector 36 is used only on start up after power has been cut off from the servo motors. What the controller and servo motors do is to vary the speed of the conveyor from the linear or constant profile depicted in FIG. 5.

The Inventive Embodiment of FIGS. 6-8

In FIG. 6, there are illustrated 22 retail size rolls each having a dimension d_L which advantageously may be 4.500". Twenty-two of such rolls yields 99" total usable length again with the trim at each end again being designated 26, 27. The difference here can be readily appreciated from a comparison of FIG. 8 with FIG. 5. In FIG. 8 the velocity profile V_C shows first an acceleration and then a deceleration between cuts. This then permits larger length rolls as has been depicted in FIG. 6 at d_L. The servo controller 29 makes this change possible merely by operating a push-button to set the axial length at the desired value. Such as controller is commercially available from Giddings & Lewis Company located in Fondulac, Wisconsin under Model No. PIC-900.

In similar fashion, the invention provides means for shortening the roll lengths of FIG. 2. This is illustrated by the showing in FIG. 9 where first there is a deceleration followed by an acceleration in the speed V_C of the conveyor between saw cuts.

Embodiment of FIGS. 10-12

As pointed out previously, it is possible according to the invention, to match the conveyor speed to the blade speed during cutoff and also to speed up or slow down the conveyor between cuts. For illustration, the showing in FIG. 10 is again of a product axial length d_L of 4.500" with the usual trim 26 and 27. What is different between the embodiment of FIGS. 10-12 and that of FIGS. 6-9 is that the speed of the conveyor V_C during the cut matches the sinusoidal saw motion as can be readily appreciated from the portion C of FIG. 12.

While in the foregoing specification a detailed description of an embodiment of the invention has been set down for the purpose of illustration, many variations in the details hereingiven may be made by those skilled

in the art.

Claims

1. Method of operating a skewed orbiting saw (23) for transversely cutting continuously advancing elongated lengths of multi-ply web material into shorter lengths, said saw (23) having a substantially constant speed component (V_B) parallel to said elongated lengths during cutting; the method comprising advancing said elongated lengths at a speed (V_C) substantially equal to said saw speed component during cutting,

   characterised by setting the desired length of said shorter lengths, and varying the speed of advance of said elongated lengths between consecutive cuts from said substantially equal speed, while maintaining said saw at said substantially constant speed, by producing

   first an acceleration followed by a deceleration if the setting requires a spacing between cuts greater than the spacing that would be produced by said equal speed, and

   first a deceleration followed by an acceleration if the setting requires a spacing between cuts less than the spacing that would be produced by said equal speed.

2. The method of claim 1 in which the speed of advance of said elongated length during cutting is varied to match the sinusoidal motion of the saw.

3. Apparatus for carrying out the method of claim 1:

   comprising a frame (20);
   conveyor means (22) on said frame (20) for advancing said elongated lengths along a linear path;
   a saw (23) mounted on said frame for movement through an orbit skewed with respect to said path, said saw having a substantially constant speed component (V_B) parallel to said linear path during cutting;
   drive means (30) operably associated with said conveyor means (22) for advancing said elongated lengths at a speed (V_C) substantially equal to said saw speed component during cutting,

   characterised in that the drive means (30) includes a settable servo controller (29) which varies the speed of advance of said elongate lengths between consecutive cuts from said substantially equal speed by producing,
   first an acceleration followed by a deceleration if the setting requires a spacing between cuts greater than the spacing that would be produced by said equal speed, and
   first a deceleration followed by an acceleration if the setting requires a spacing between cuts less than the spacing that would be produced by said equal speed.

4. Apparatus according to claim 3 wherein the servo controller is arranged to vary the speed of advance of the elongated length during cutting to match the sinusoidal motion of the saw.

Patentansprüche

1. Verfahren zum Betreiben einer schräggestellten Umlaufsäge (23) zum Querzerschneiden kontinuierlich durchlaufender langer Abschnitte eines mehrlagigen Bahnmaterials zu kürzeren Abschnitten, wobei die Säge (23) während des Schnitts eine im wesentlichen konstante Geschwindigkeitskomponente (V_B) parallel zu den langen Abschnitten aufweist und die langen Abschnitte während des Schnitts mit einer Geschwindigkeit (V_C) vorgeschoben werden, die im wesentlichen gleich der Geschwindigkeit der Säge ist,

   dadurch gekennzeichnet, daß man die Sollänge der kürzeren Abschnitte einstellt und die Vorschubgeschwindigkeit der langen Abschnitte zwischen aufeinanderfolgenden Schnitten von der im wesentlichen gleichen Geschwindigkeit ausgehend variiert, während man die Säge auf der im wesentlichen konstanten Geschwindigkeit hält, indem man

   erst eine Beschleunigung und dann eine Verlangsamung erzeugt, falls die Einstellung einen größeren Abstand zwischen den Schnitten als den bei der gleichen Geschwindigkeit entstehenden verlangt, und

   erst eine Verlangsamung und dann eine Beschleunigung erzeugt, falls die Einstellung einen kleineren Abstand zwischen den Schnitten als den bei der gleichen Geschwindigkeit entstehenden verlangt.

2. Verfahren nach Anspruch 1, bei dem die Vorschubgeschwindigkeit der langen Abschnitte während des Schnitts variiert wird, um sie der Sinusbewegung der Säge anzupassen.

3. Vorrichtung zum Ausführen des Verfahrens des Anspruchs 1 mit

   einem Gestell (20),
   einem Förderer (22) auf dem Gestell (20), mit dem die langen Abschnitte entlang einer gradlinigen Bahn vorschiebbar sind,
   einer Säge (23), die auf dem Gestell auf einer Umlaufbahn bewegbar gelagert ist, die gegenüber der Bahn schräggestellt ist, wobei die Säge während des Schnitts eine erhebliche konstante Geschwindigkeitskomponente (V_B)

parallel zur gradlinigen Bahn hat, und

einem Antrieb (30), der betrieblich dem Förderer (22) zugeordnet ist, um während des Schnitts die langen Abschnitte mit einer Geschwindigkeit (V_C) vorzuschieben, die im wesentlichen gleich der Geschwindigkeit der Säge ist,

dadurch gekennzeichnet, daß der Antrieb (30) eine einstellbare Servosteuerung (29) aufweist, die die Vorschubgeschwindigkeit der langen Abschnitte zwischen aufeinanderfolgenden Schnitten von der im wesentlichen gleichen Geschwindigkeit ausgehend variiert, indem sie

erst eine Beschleunigung und dann eine Verlangsamung erzeugt, falls die Einstellung einen größeren Abstand zwischen den Schnitten als den bei der gleichen Geschwindigkeit entstehenden verlangt, und

erst eine Verlangsamung und dann eine Beschleunigung erzeugt, falls die Einstellung einen kleineren Abstand zwischen den Schnitten als den bei der gleichen Geschwindigkeit entstehenden verlangt.

4. Vorrichtung nach Anspruch 3, bei der die Servosteuerung so eingerichtet ist, daß sie die Vorschubgeschwindigkeit der langen Abschnitte während des Schnitts der sinusförmigen Bewegung der Säge anpaßt.

Revendications

1. Procédé de commande d'une scie orbitale inclinée (23) destiné à une coupe transversale de tronçons allongés qui avancent de façon continue, formés d'un matériau de nappe à plusieurs couches, en tronçons plus courts, la scie (23) ayant une composante de vitesse pratiquement constante (V_B) parallèle aux tronçons allongés pendant la coupe, le procédé comprenant l'avance des tronçons allongés à une vitesse (V_C) qui est pratiquement égale à la composante de vitesse de la scie pendant la coupe,

caractérisé par le réglage de la longueur voulue des tronçons relativement courts et la variation de la vitesse d'avance des tronçons allongés entre les coupes consécutives par rapport à la vitesse pratiquement égale, avec maintien de la soie à la vitesse pratiquement constante, par réalisation

d'abord d'une accélération suivie d'une décélération lorsque le réglage nécessite un espacement entre les coupes supérieur à l'espacement produit par la vitesse égale, et

d'abord une décélération suivie d'une accélération lorsque le réglage nécessite un espacement entre les coupes inférieur à l'espacement qui serait produit par la vitesse égale.

2. Procédé selon la revendication 1, dans lequel la vitesse d'avance du tronçon pendant la coupe est modifiée afin qu'elle corresponde au mouvement sinusoïdal de la scie.

3. Appareil destiné à la mise en oeuvre du procédé selon la revendication 1, comprenant :

un châssis (20),

un dispositif transporteur (22) placé sur le châssis (20) et destiné à faire avancer les tronçons allongés suivant un trajet linéaire,

une soie (23) montée sur le châssis afin qu'elle se déplace suivant une orbite inclinée par rapport audit trajet, la soie ayant une composante pratiquement constante de vitesse (V_B) qui est parallèle au trajet linéaire pendant la coupe,

un dispositif d'entraînement (30) associé pendant le fonctionnement au dispositif transporteur (22) afin qu'il fasse avancer les tronçons allongés à une vitesse (V_C) qui est pratiquement égale à la composante de vitesse de la scie pendant la coupe,

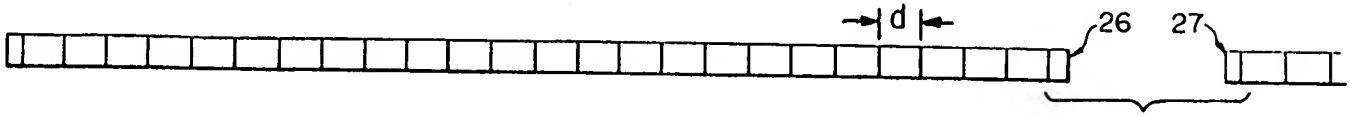
caractérisé en ce que le dispositif d'entraînement (30) comporte un organe réglable (29) de commande d'asservissement qui fait varier la vitesse d'avance des tronçons allongés entre les coupes successives par rapport à la vitesse pratiquement égale, par production

d'abord d'une accélération suivie d'une décélération lorsque le réglage nécessite un espacement entre les coupes supérieur à l'espacement qui serait produit par la vitesse égale, et

d'abord une décélération suivie d'une accélération lorsque le réglage nécessite un espacement entre les coupes inférieur à l'espace qui serait produit par la vitesse égale.

4. Appareil selon la revendication 3, dans lequel l'organe de commande d'asservissement est destiné à faire varier la vitesse d'avance du tronçon allongé pendant la coupe afin qu'elle corresponde au mouvement sinusoïdal de la scie.

FIG. 3
PRIOR ART



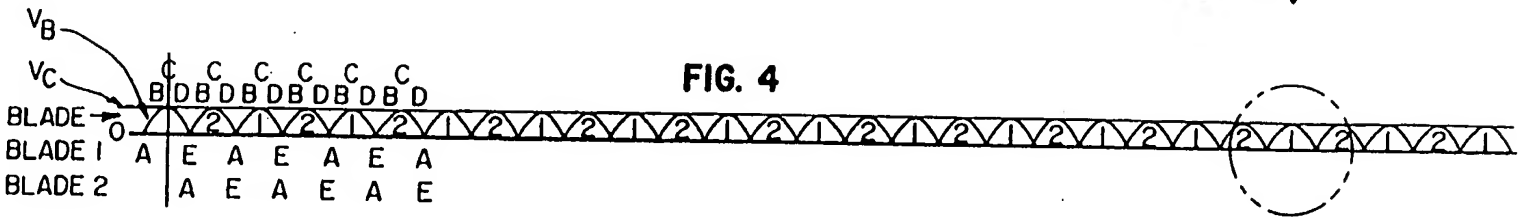


FIG. 4

FIG. 2

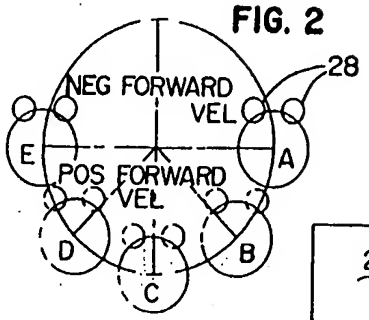


FIG. 5

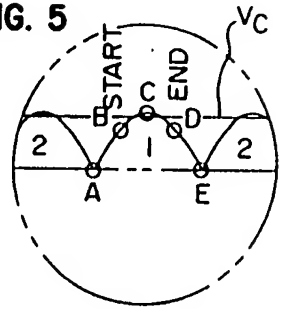
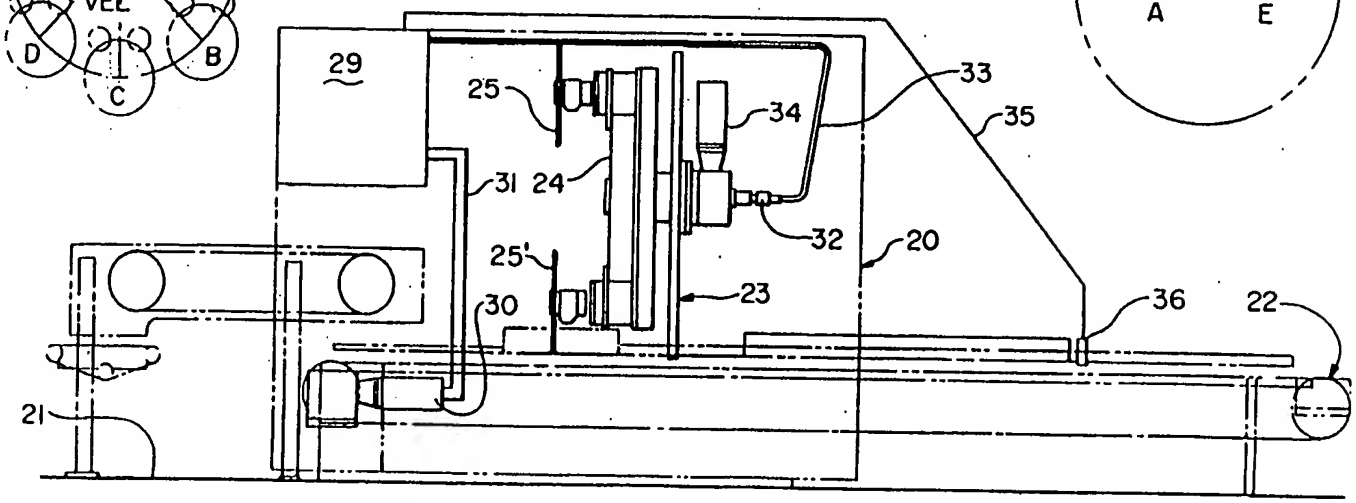


FIG. 1



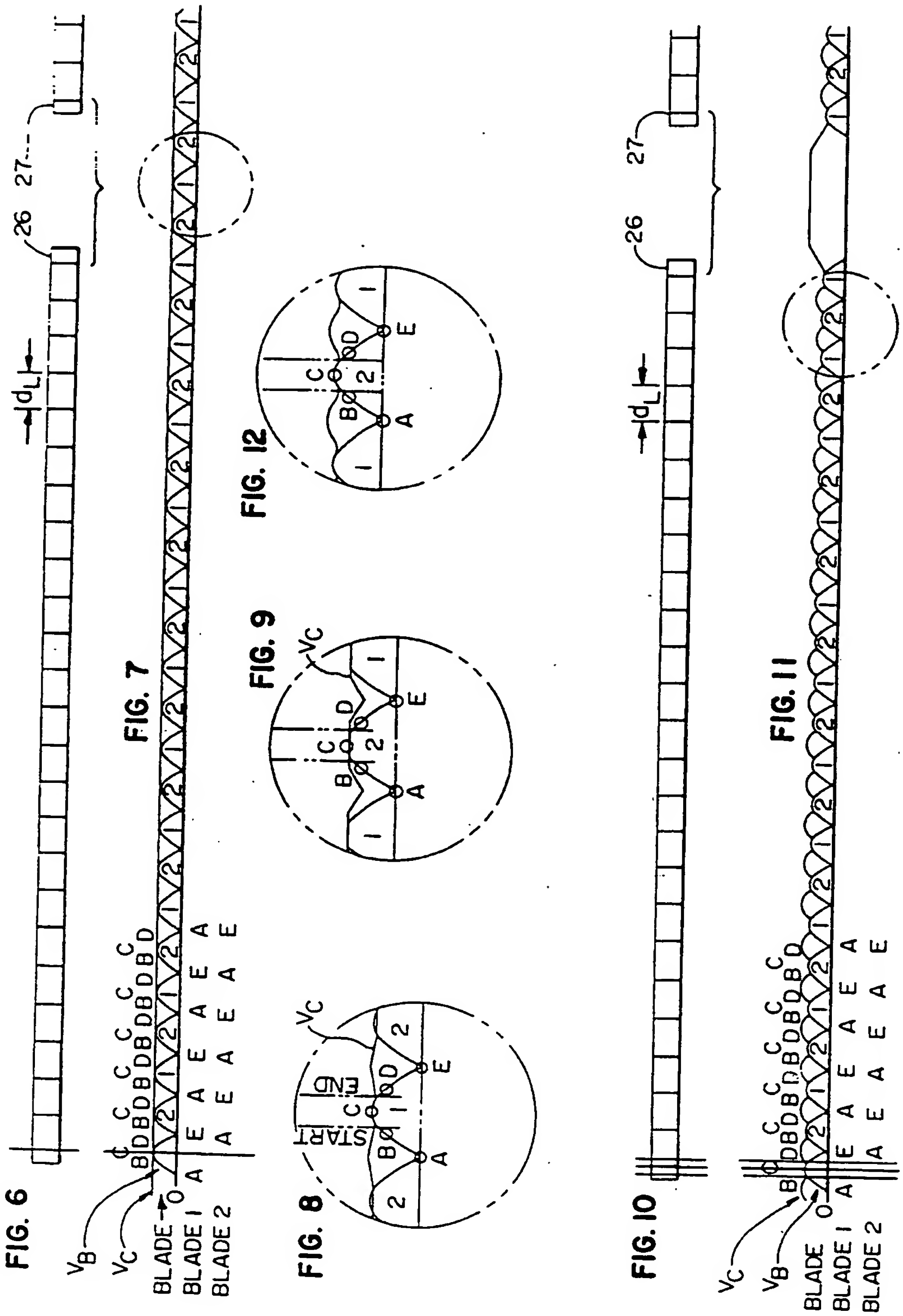


FIG. 6
FIG. 7
FIG. 8
FIG. 9
FIG. 10
FIG. 11
FIG. 12
26
27
BLADE
BLADE 1
BLADE 2
START
END